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"WHY MUST TAXES BE CONSIDERED IN PROFITABILITY STUDIES?"*

by

James B. Weaver
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Correct profitability comparisons cannot be made before taxes. The importance of depreciation allowances relative to profit are properly indicated only on an after-tax basis. Profits from foreign subsidiaries receive special treatment under the tax laws which will affect their after-tax profitability relative to domestic ventures. In comparing rate of return calculations to a cut-off point or minimum acceptable return, the cost of capital, before-tax comparisons will not show the proper relation of cost of borrowed to equity funds. Even in establishing the investment base for a project, taxes have a major effect on working capital required, and must therefore be considered.

No one needs to be told that taxes affect <u>absolute</u> profitability - the question is whether they affect <u>relative</u> profitability of alternative proposals. Several references (1, 7, 8) indicate that it is of no consequence whether engineering economy studies are made before or after the application of income taxes. The assumption seems to be that, as long as all projects are considered on the same basis (that is, all before taxes or all after taxes), the application of taxes will merely multiply the answer in every case by some forecast tax rate. The main thesis of the following pages is that such an assumption is false, which has been stated

*Presented before the Engineering Economy Division at the annual meeting of the American Society for Engineering Education at Ithaca, New York, in June 1957.

elsewhere (3, 10).

Two cases will be shown where relative profitability is affected by the income taxes involved. The establishment of the proper cut-off point, or minimum acceptable rate of return, will be shown to be affected by taxes. The proper determination of working capital will be shown to depend on full consideration of taxes and their accrual.

This paper is not prepared by a tax expert. My intent is to indicate the importance of their consideration, not to cover all facets of their application, even in the areas discussed.

DEPRECIATION ALLOWANCES CAUSE A DIFFERENCE

Allowance for depreciation in the United States tax law results in tax differences depending upon the ratio of depreciable to non-depreciable assets involved in the project. Even though real costs and income may be equal on two projects, their reported net income for tax purposes will not be the same if the two projects do not have the same value of depreciable property.

To make this point clear, consider two projects at the two extremes. The first requires an investment which is completely depreciable such as buildings or equipment; the second, a completely non-depreciable investment such as inventories or land. Completely non-depreciable investments other than real estate are not common; however, a project to improve distribution in a given area might approximate such a condition, assuming that a warehouse was already available and only inventories needed to be added.

Figure 1

Effect of Taxes on Relative Profitability Depending on Investment Type (Taxes @ 50%)

Type	Fixed Plant (100% depreciable)	Inventory, Land, Etc. (non-depreciable)
Investment	$40,000	$40,000
Per Year:		
Gross Income	50,000	50,000
Costs requiring cash outlay (excluding depreciation)	30,000	30,000
Depreciation allowance (10 yr., straight line)	4,000	--
Total costs for tax purposes	34,000	30,000
Before Taxes:		
Reported net income	16,000	20,000
Cash generation (income plus depreciation)	20,000	20,000
After taxes:		
Reported profit	8,000	10,000
Cash generation	12,000	10,000
Interest Rate of Return (discounted cash flow)	28%	25%

Figure 1 presents this comparison. The first column applies to the investment in depreciable fixed facilities; the second column, to the non-depreciable investment. Equal investments of $40,000 are made in the two projects. Gross income of $50,000 is also exactly equal for the two projects, as are costs requiring cash outlay. These costs exclude depreciation, since no cash outlay is required corresponding to the item in the cost statement marked depreciation. Assuming a 10-year straight line depreciation had been allowed on the fixed investment, (left hand column), $4,000 depreciation could be reported as costs each year.

Nothing corresponding to this occurs in the second column of figures on the non-depreciable investment. The total costs for tax

purposes in the first column are therefore $4,000 higher than the corresponding costs in the second column.

Subtracting these costs from gross income, reported net income for the depreciable investment will be $16,000 and, for the non-depreciable investment, $20,000. Of course, the $4,000 has not really been expended and is still in the coffers of the company making this investment. Therefore, the total cash generation due to the project is $20,000 in either case. Looking only at these before-tax numbers, it looks as if the non-depreciable investment is equal to the fixed investment in total cash generation and greater than the depreciable investment in reported net income. The conclusion would certainly be that it was at least as good as the depreciable investment.

Now look at the after-tax figures. Assuming 50% taxes on reported net income, $8,000 profit shows in the first column and $10,000 in the second column. However, again, in the depreciable case, the $4,000 allowed as depreciation is still intact in the company coffers. Therefore, the total cash generation from this project is $12,000. The depreciable investment, evaluated on an after-tax basis, is <u>better</u> than the non-depreciable investment. This is the reverse of the before-tax conclusion.

Evaluated as an interest rate of return on investment by discounted cash flow techniques (2, 3, 13), the depreciable investment shows 28% annual interest rate of return as compared to 25% for the non-depreciable investment.

Interpreted in plain words, this means that part of the initial amount of the depreciable investment is recovered through depreciation allowances each year, whereas no recovery of non-depreciable

investment is possible until the termination of that project.

Clearly, taxes treat these two projects in a different manner and affect the comparison between them. Although extreme examples have been chosen to make the difference clear, it should be apparent from these examples that any difference in the ratio of depreciable and non-depreciable assets will be reflected in a difference in tax treatment under the present laws. It therefore seems essential that taxes be considered in profitability comparisons so that projects of every nature can be compared.

Incidentally, 100% recovery at project termination has been assumed, but any growth in, say, land value would introduce capital gains taxes which would affect profitability.

Again, depletion allowances could be shown to have another, different effect on relative profitability. Further examples of this type of tax effect on profitability, discussing particularly the effect of accelerated depreciation on profitability, will be found in the publication of the Engineering Economics Division of the American Society for Engineering Education, The Engineering Economist (9).

PROFITS FROM SUBSIDIARIES CAUSE A DIFFERENCE; FOREIGN INVESTMENTS

Another entirely unrelated factor in investments which requires the consideration of taxes for proper evaluation is the special provision in the tax laws regarding distribution of profits from subsidiary companies (4, 12). Distribution of profits from any subsidiary, domestic or foreign, is taxed differently from profits within a single corporation. However, the domestic dividend tax is small and the impingement of taxes on foreign investments is

discussed below as the more important example of this effect.

The U. S. government has no power to tax the income of foreign corporations earned outside the United States. Therefore, the profits from investments in foreign subsidiaries are not subject to U. S. taxes until they are returned to the parent U. S. company. Then distributed, such profits are subject to ordinary corporate income taxes, but credit is made against the tax for foreign taxes previously paid on that income.

FIGURE 2

EFFECTIVE TAXES ON PROFIT DISTRIBUTION FROM FOREIGN SUBSIDIARIES

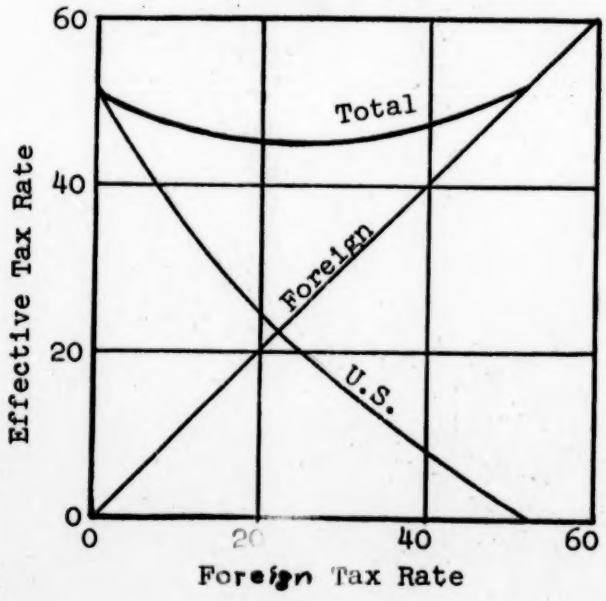

Figure 2 shows the total effect of this difference. The effective tax rate is plotted against the foreign tax rate. The current 52% corporation tax for U. S. profits is the total effective tax rate for zero foreign tax rate. As foreign tax rate increases, the U. S. tax decreases faster resulting in a total tax of less than 52%. The total tax can go as low as 45%, for a foreign tax rate of about 26% and for foreign tax rates between 26 and 52%., the total tax rises slightly but is still less than the 52% U. S. tax rate.

For instance, if a foreign tax rate of 10% had been paid on a net profit of 100 units, the dividends available for distribution would be 90 units. These 90 units if received by a U. S. company would be subject to a 52% corporate income tax or about 47 units, but this tax would be reduced 10% of the 90 units, leaving an actual U. S. tax of 38 units. The total tax paid on the 100 units of net profit would therefore be 48 units. As long as the foreign tax rate is less than the U. S. rate (but not zero), total tax will always be less than the U. S. tax alone on the same amount of domestic income.

On foreign investments, then, no one would ignore such a tax advantage. A foreign investment on which profits were to be distributed to the United States, subject to a foreign tax between 0 and 52%, would be more profitable than an exactly equivalent domestic investment. As the simplest method of recognizing the advantage, calculation of profitability should be made after taxes.

INTEREST DEDUCTIONS CAUSE A DIFFERENCE; COST OF CAPITAL

The return on investment of a project must be compared with some minimum rate of return chosen as a standard. The literature in recent years has tended to accept the forecast of a company's cost

of capital as a proper basis for comparison or cut-off point (2).

Although a complete method for calculating or forecasting the company's cost of capital is a subject for some controversy in the literature, (2, 5, 6, 11), it has also been stated that the cost of equity capital can be approximated by the company's earnings to price ratio which measures the return to the stockholder.

The cost of borrowed capital is better known and is usually expressed as the annual interest rate required by the banks for lending money. Presumably, a company's combined cost of capital would be calculated using the proper proportion of capital at equity cost and capital at the borrowed cost.

But what about the tax treatment of the two sources of capital? The borrowed capital is, of course, tax deductible and therefore, assuming 50% taxes, only costs the company net about half the rate paid the banker. In calculating a combined cost of capital, therefore, the effect of taxes must be taken into account to get a true cut-off point.

FIGURE 3

Effect of Taxes On Cost Of Capital

	Before Taxes	After Taxes
50% Equity @	10%	10%
50% Borrowed @	5%	2-1/2%
Average	7-1/2%	6-1/4%

Figure 3 shows, with some purely arbitrary figures how this effect of taxes would be involved. Consider a company using 50% equity capital and 50% borrowed capital. Assume that they are

borrowing at 5% and that they are maintaining an earnings to price ratio of about 10%, which we will also assume represents the equity cost of capital. On a before-tax basis, the proper cut-off point for investment would be 7-1/2%. However, after taxes, the borrowed capital costs them only 2-1/2% and the combined cost of capital is reduced by 1-1/4 percentage points.

Such a cost of capital can only properly be computed after tax consideration - and, furthermore, it can only be compared with after-tax rates of return.

TAX ACCRUALS CAUSE A DIFFERENCE

You are doubtless aware of the 1954 changes in the provisions for payment of corporate income tax. Only since then has any income tax been paid during the earning year. Figure 4 shows the present schedule by which industrial companies (liable for taxes over $100,000 a year) are required to pay taxes for 1957, 1958, 1959 and succeeding years. Based on your estimated tax liability for 1957, your first payment of 1957 corporation taxes will be due September 15, 1957. 15% of the estimated liability must be paid at that time; another 15% is due December 15. Under the present schedule, even after 1959, only 50% of the estimated income taxes need be paid by the end of the year in which they are earned. Note also that the "estimated liability" may be based on an actual estimate of your taxes for the year or may be based on the previous year's tax. The law specifically provides for this so that if a corporation wishes it may choose the lower of these two figures. (However, penalties apply if an estimate is used which is below a certain percentage of actual liability).

FIGURE 4

Tax Liability; Schedule of Payments

Year	1957	1958	1959 and Succeeding	Basis
September 15	15%	20%	25%	of Est. Liability
December 15	15%	20%	25%	" " "
March 15*	File return and pay 1/2 of balance			
June 15*	Pay balance			

*of succeeding year

"Estimated Liability" may be based on actual estimate or on last year's tax.

Subsequent installments of 1/2 of the balance of the actual tax for 1957 must be paid on March 15 when the return is filed, and on June 15, 1958.

My point here is not concerned with the differences among the years, but only with the fact that, during any year, accrued taxes payable, but not yet due, provide a considerable pool which may be used as working capital. Even assuming 50% tax and four equal payments (representing 1959 and after), about seven month's worth of profits after tax are available at any time as a source of working capital. More than that will, of course, be available until 1959.

It is plain that the effect of such accrued taxes on the maintenance of working capital in a corporation is considerable. The rules of thumb that are commonly used for estimation of working capital do not seem to account for this fund of accrued taxes. Again, however, if taxes are not considered at all in making engineering economic studies, this effect of accrued taxes on working capital cannot be included. Excess working capital will be forecast, resulting in an unduly large investment base.

Before a panel on taxes was complete, someone would have to bring this up. Being the first speaker, I will take advantage of the timing to quote the famous statement of Ben Franklin in 1789, "In this world, nothing is certain but death and taxes." Perhaps, these days, we should add inflation to the other two certainties. However, death does not affect us all equally. Detailed and voluminous actuarial tables are necessary to consider their affect properly. In the same way, taxes do not affect every investment project equally. Just as each of us must prepare for the uncertain effects of the death of others on our own lives (and the effect of our own death on others), we must study and evaluate the uncertain effect of taxes on the investment projects we are considering.

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HANDLING OF INCOME TAXES IN ENGINEERING ECONOMY STUDIES FROM THE PUBLIC UTILITY VIEWPOINT*

by

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Income Taxes, particularly Federal Income Taxes, are a large element in the total cost of the service supplied by private utilities. In comparison with commercial and industrial concerns, a larger proportion of gross revenue is paid out for income taxes by the utilities. Consequently, evaluation of the income tax element is of major importance in utility economic studies.

A comparison of the basic financial characteristics of utilities and industrials is presented, together with the computations for a typical method of arriving at appropriate Federal income tax rates for use in utility economic studies. In connection with the latter, the effects of differences in methods of financing and of accruing depreciation for income tax purposes are outlined.

BASIC CHARACTERISTICS OF UTILITY BUSINESS

As a regulated monopoly the utility is permitted to charge rates based on its total costs including a fair return on the value of its properties, after payment of applicable income taxes. However, it is also required to render service to the extent demanded by its customers and-subject to certain regulatory safeguards - must expand in accordance with the growth of the community it serves.

*Presented before the Engineering Economy Division at the annual meeting of the American Society for Engineering Education at Ithaca, New York, in June 1957.

In contrast with the usual commercial or industrial enterprise, the utility derives practically all of its earnings from the experienced return on its rate base. The element of profit on sales or services is generally absent; increases in operating cost do not generate any increase in profits.

The return allowed to utilities is in the 5% to 6% range, based on the depreciated value of the property employed in doing business. However, there are marginal elements of the privately-owned utility business where the experienced return may be substantially lower. In particular the hearing business, both gas and steam; traction power supply; and the municipal or governmental business of the private utility tend to exhibit a relatively low rate of return. (Publicly-owned utilities are not considered in this paper.)

In order to illustrate the financial structure of the utility and its effect on income taxes, Figure 1 has been prepared, summarizing certain basic relationships for Class A and B Electric Utilities in the United States and for Gas Pipelines in comparison with similar data for the Ten Largest Steel Companies and for General Manufacturing.

Plant Cost - The original cost of the plant required by the average utility is $3 to $4 per dollar of gross revenue, which is far more than the plant investment of even the "heavy industry" element as represented by the steel companies. During the war the trend of this ratio for the utilities was downward, but in the past few years the trend has reversed and it is now rising.

Reserves - For the utilities, depreciation reserves are in the 20 to 25% range as compared with 40 to 50% for the industrials, reflecting the relatively long-lived property involved as well as the

"current cost" philosophy of regulation which prohibits undue accrual of depreciation for rate-making purposes. The trend of this ratio is fairly level by virtue of capital increments balancing current accruals.

Book Value or cost less accrued depreciation, therefore, is even higher - relative to the industrials - than the corresponding original cost ratio.

Outstanding Debt - The relatively long-lived assets of the utilities plus the stability associated with their monopoly status permit mortgage financing to the extent of 40 to 60% of plant cost, whereas industrial debt ratios are in the 5 to 15% range. Under pressure for new construction funds the traditional 50% for conservative electric utilities has been tending to rise.

"Taxable" Plant - The equity interest for the utilities (the portion of the plant with earnings subject to income tax) is also higher than for the industrials per dollar of gross, despite the higher debt ratios.

Income Taxes - Federal income taxes take almost one-eighth of the electric utility revenue dollar; far more than industrial tax payments. But the ratio of income tax to equity or "taxable plant" is only 9% or considerably less than it is for the industrials. (Since a 52% tax rate is involved, the rates of return on equity would approximate 90% of the indicated ratios of tax to "taxable" plant.)

It is apparent, therefore, that the low rate of return for utilities is more than offset by the high plant investment, resulting in a very high Federal income tax component of total costs.

Depreciation Accruals - The relative magnitudes of the annual accruals for depreciation are also of interest in this comparison.

The current rates are about 2½% of original cost for the utilities and 10% for the industrials. These accruals plus any excess of earnings over payout are available for financing expansion. For the electric utilities as a whole current expansion programs are running 8½% of original cost, leaving 6% per year to be financed from other sources.

The average electric utility, therefore, is currently faced with the necessity of raising new capital equivalent to about 25% of its annual gross revenues by equity or debt financing, retaining earnings and/or by adopting one of the new "liberalized" depreciation methods permitted under the 1954 income tax law. (The latter source may not be available to many utilities, since the regulatory pattern which ultimately evolves may not permit the utility to retain the so-called "tax savings".) In view of these facts it is apparent that economy in the expenditure of capital funds is a major problem for the public utilities.

GENERAL NATURE OF UTILITY ECONOMIC STUDIES

As with any other business, the conditions of the problem are controlling with respect to the basic approach to a solution. Three generalized problems may be recognized, as follows:

a. Average Cost Problems
b. Short Range Situations
c. System Planning

The distinction among these types of problems involves the source of financing, the basis of depreciation charges and the incidence of income taxes, as far as this paper is concerned. (Parallel distinctions exist, of course, involving operating and maintenance

costs, fuel consumption, property taxes and the like.)

Average Cost Problems relate basically to the allocation of existing property and associated costs among existing uses. Examples are: routine determinations for intra-company allocations among portions of the business, e.g. Electric vs Gas or Steam; Regulated vs Non-Regulated Business; Rural vs Urban Territory; etc. Also, purchase or sale of capacity or reserves between interconnected utilities; establishment of general rate structures; writing or renewing long-term contracts; leases; etc. In general these problems involve the existing rate base, method of financing, interest rates and depreciation schedules for tax and book purposes, developed for the enterprise as a whole or for a relatively limited number of subdivisions thereof. Rate of return may be based on experienced earnings or may reflect an objective such as 6% on book value; frequently more than one objective is established to allow for permissible variations among the segments of the business. The Federal income tax element, then, may be the experienced rate allocated on the basis of taxable earnings - or a calculated value predicated on the established earnings objective.

Short Range Situations arise where the economic evaluation does not rest on the basic principle that rates (i.e. - revenues) reflect cost, which is implicit in the preceding comments. Utility rates do contain escalation clauses - notably those which introduce automatic adjustments of revenue in accordance with changes in the price of fuel - but they are basically fixed for relatively long periods of time. Consequently, the rate of return for a given utility will fluctuate, reflecting changes in prices, wages, tax rates and other costs, until the return gets "out of line" with the regulatory

allowance, at which time a revision in rate structure is made to correct the situation.

Typical of the problems encountered are those involving the timing of maintenance jobs and the replacement of property. Generally speaking, utilities account for the replacement of motors, pumps and similar component items as maintenance rather than capital, and the costs of such work are deductible for income tax purposes when spent. When such work is necessary in order to maintain the integrity of the property, no questions arise. But the work is undertaken frequently in order to secure temporary gains in efficiency or reductions in collateral costs. The economic study, then, must recognize the cost of utilizing scarce funds for the work, in advance of the time necessity might dictate, and is usually based on an "out-of-pocket" appraisal, possibly assigning interest cost only to the use of the funds, and with due allowance for the offsetting effect of income taxes on the costs and savings anticipated.

System Planning Problems constitute the bulk of the economic studies encountered in utility practice. Here the basic principle that future revenues will equal future costs is followed, provided that the evaluation is based on a future rate of return acceptable to the regulatory authorities. In its simplest form planning may involve the determination of the rate to charge for new or additional business or a decision among alternative proposals for accomplishing a given objective, such as the addition of a given amount of generating capacity. At the other end of the scale the problems can become extremely complex, involving retirement of existing facilities, coupled with reuse or partial reuse thereof plus investment in new plant under several alternative schemes.

Examples include conversion of manufactured gas to natural gas distribution; converting an overhead electric system to an underground one; introducing a higher distribution voltage in an existing system to cope with load increases; etc.

An important aspect of those problems involving the retirement and/or reuse of existing facilities relates to the unrecovered tax loss on existing plant and the immediate tax credit arising therefrom. Again, the practice of capitalizing interest during construction results in a portion of the book cost of the property which is depreciable for book purposes but non-depreciable for tax purposes, since the tax deduction is taken during the construction period when the interest is paid.

In general, therefore, utility economic studies involve a combination of immediate income tax effects and future tax costs associated, perhaps, with a number of different life cycles embracing the new or reused elements of the properties involved in alternative proposals for accomplishing the objective in view. Under these circumstances a present-value approach to their solution is almost always required.

COMPUTATION OF FEDERAL INCOME TAX COST

To illustrate the application of these considerations, Figure 2 has been prepared, showing a computation of Federal income taxes - in per cent of original cost - for three life periods, based on 6% return after taxes. The calculation assumes straight line depreciation, annual compounding of interest and zero net salvage.

Deducting straight line depreciation from the capital recovery factor - as indicated in Figure 2 - gives the portion of

annual capital recovery available as "net earnings". This figure is the uniform annual equivalent (on a compound interest basis) of the non-uniform earnings which would be derived by applying 6% return to the declining book values resulting from the assumption of straight line depreciation. Consequently, the ratio of uniform net earnings to 6% is a measure of the average book value. The bond interest assumption, in this example, is that bonds outstanding will equal 40% of book value, with a 4½% net interest rate (i.e. - 1.7% of book value). The interest deduction for tax purposes, therefore, is 1.7% of the average book value and the Federal income tax may be calculated directly, as shown in Figure 2.

The sum of the income tax rate and the capital recovery factor gives the basic carrying charge rate for use in engineering economy studies. Other elements of cost related to the investment under consideration may be added directly - if they are uniform, in ratio to the original cost, over the life of the property. If not, the uniform annual equivalent on a present value basis may be calculated and used as part of the total carrying charge.

For non-depreciable property (i.e. - land and the salvageable portion of original cost) the computation of income tax would be similar, e.g.:

Capital Recovery	6.000%	
Average Book Value	100%	
Earnings Before Tax	6.000	+ X
Bond Interest @ 1.7%	1.700	
Taxable Earnings	4.300	+ X
Income Tax @ 52%	4.658%	
Carrying Charge Rate	10.658%	

Capital recovery factors for other life cycles and for various rates of return and periods of compounding are given in Figure 3.

EFFECT OF VARIOUS TAX DEPRECIATION BASES

For plant installed since 1953, the income tax laws permit the computation of depreciation for tax purposes on various liberalized bases. The utilities, in general, are adopting the sum of the years' digits method or the declining balance method for their tax returns, and the income tax component of an economic study is affected thereby.

Disregarding the accounting and regulatory problems associated with the adoption of liberalized depreciation, the economic effect is confined to a large reduction in the equivalent uniform annual tax as compared with the straight line basis. Capital recovery for a given investment is obviously unaffected.

Figure 4 is a chart of the tax depreciation charges arising under the Sum of the Years' Digits (S.Y.D.) and Declining Balance methods in comparison with the Straight Line method for three life periods and assuming no salvage. The points for the declining balance method were calculated based on twice the straight line rate with no cut-off (i.e. - return to a straight line basis) until the last year. The changes in income taxes year by year (assuming a constant tax rate) are inversely proportioned to the depreciation charges shown, and a present value appraisal thereof is obviously required.

The tabulations in Figures 5 and 6 give the basis for such an appraisal, for a discount rate of 6% and for the various life periods shown. These tabulations give the appropriate yearly depreciation factors for the S.Y.D. and Declining Balance methods together with the present values of each factor and a computation of the uniform annual equivalent depreciation for each life period.

Using the figures for 25 years service life for illustration, the income tax savings under the liberalized bases, as compared with straight line, would be as follows:

	S.Y.D.	Declining Balance
	(Per Cent of Original Cost)	
Uniform Annual Equivalent of Depreciation Charges:		
Liberalized Basis	4.9009	4.5673
Straight Line	4.0000	4.0000
Excess	0.9009	0.5673
Tax Saving @ 52% .52/.48 x Excess	0.976	0.615
Income Tax - Straight Line Basis (From Figure 2)	2.968	2.968
Income Tax - Liberalized Basis	1.992	2.353

Generally speaking, the declining balance method is less favorable to the taxpayer than the S.Y.D. method, as is indicated by the ratios shown on the last lines of Figures 5 and 6. For lives shorter than 10 years, however, declining balance may become more favorable. An illustration of the income taxes payable under S.Y.D. as compared with straight line is shown in Figure 7. The calculated annual taxes at the 52% rate under each method have been plotted for both 25 and 50 year life periods to show the extreme range of tax payments under the S.Y.D. method. The average annual payments under each method are identical, of course, as shown by the bar charts, but the equivalent level annuities are much lower under the S.Y.D. method, as indicated in the foregoing discussion. (The level annuity figures for the declining balance method would be plotted on the bar charts at approximately 2.4% for 25 year life and 2.8% for 50 year life.)

IMPACT OF FINANCING ON UTILITY COSTS

In connection with Figure 1, it was indicated that the proportion of Federal income taxes to revenue, industry-wide, was about one-eighth. This average includes a wide range of individual situations, influenced by the financial characteristics and operating costs of the individual company.

The tabulations in Figures 8 and 9 will serve to illustrate the possible differences. Figure 8 shows a comparison of fixed charge rates as anticipated several years ago for OVEC, a large generating corporation, with a hypothetical situation involving the Consolidated Edison Company. OVEC, with a government contract to build plants and supply the power for an AEC installation, was able to finance its construction with 80% bonds and a relatively minor equity on the part of its owners. Consequently, as compared with the 50% debt situation portrayed for Edison, its over-all cost of money was substantially lower, despite higher interest and equity earning rates. Anticipated income taxes at the 50% rate assumed for the study were about one-fourth as great as for the "normal" financing exemplified by the Edison situation.

In Figure 9 these rates were used in the development of total annual costs for generation by OVEC in comparison with a possible Edison plant. Over-all, the Edison costs would be much higher than the OVEC costs, reflecting the greater investment required, high local property taxes, and fuel prices almost double those expected for OVEC. But, despite the higher gross revenue required, Federal income taxes would amount to 9½ cents per dollar of gross as contrasted to only 4 cents for OVEC.

* * * * * * * * * * *

From the public utility viewpoint, income taxes are a large element of costs. Under the fair rate of return philosophy, as applied by the regulatory authorities, revenues - in the long run - reflect costs. Consequently, the recognition of and proper allowance for the effects of income taxes is of primary importance in utility economic studies.

UTILITIES VS INDUSTRIALS
SUMMARY OF CERTAIN BASIC RELATIONSHIPS

	ELECTRIC UTILITIES	GAS PIPELINES	TEN STEELS	GENERAL MFG.
ANNUAL GROSS REVENUE	$ 100	$ 100	$ 100	$ 100
PLANT COST	$ 400	$ 300	$ 125	$ 75
ACCRUED DEPRECIATION	90	60	50	30
BOOK VALUE	$ 310	$ 240	$ 75	$ 45
OUTSTANDING DEBT	175	150	15	5
"TAXABLE" PLANT	$ 135	$ 90	$ 60	$ 40
FEDERAL INCOME TAX	$ 12.25	$ 8.00	$ 8.25	$ 6.50
RATIO - INCOME TAX TO "TAXABLE" PLANT	9%	9%	13 3/4%	16 1/4%

FIG. 1

CARRYING CHARGE RATES
IN PERCENT OF ORIGINAL COST
—ooo—
STRAIGHT LINE DEPRECIATION BASIS

SERVICE LIFE-YEARS	10	25	50
ASSUMED SALVAGE	0	0	0
RETURN ON INVESTMENT	6.000%	6.000%	6.000%
AMORTIZATION - 6% SINKING FUND	7.587	1.823	0.344
CAPITAL RECOVERY	13.587	7.823	6.344
DEDUCT STRAIGHT LINE DEPRECIATION	10.000	4.000	2.000
NET EARNINGS	3.587%	3.823%	4.344%
AVERAGE BOOK VALUE	59.78%	63.71%	72.41%
EARNINGS BEFORE TAX (TAX=X)	3.587 +X	3.823 +X	4.344 +X
BOND INTEREST - 40% BONDS AT 4¼%			
INTEREST DEDUCTION	1.016	1.083	1.231
TAXABLE EARNINGS	2.571 +X	2.740 +X	3.113 +X
INCOME TAX AT 52%	2.785%	2.968%	3.373%

SUMMARY

CAPITAL RECOVERY	13.587%	7.823%	6.344%
FEDERAL INCOME TAX	2.785	2.968	3.373
SUM	16.372%	10.791%	9.717%

Fig. 3

TABLE OF CAPITAL RECOVERY RATES

BASED ON PAYMENTS MADE AT END OF STIPULATED PERIOD IN EQUAL INSTALLMENTS

VALUES REPRESENT NECESSARY AMOUNTS IN DOLLARS TO BE PAID ANNUALLY FOR STIPULATED PERIOD IN YEARS, EQUIVALENT TO $100 AT THE BEGINNING OF THE PERIOD

	2½ PER CENT			3 PER CENT			3½ PER CENT			3½ PER CENT		
PERIOD YEARS	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.
5	21.430	21.543	21.680	21.563	21.687	21.835	21.696	21.831	21.991	21.830	21.975	22.148
6	18.099	18.193	18.307	18.233	18.336	18.460	18.367	18.479	18.613	18.502	18.623	18.767
7	15.721	15.802	15.900	15.856	15.945	16.051	15.992	16.088	16.202	16.128	16.231	16.354
8	13.940	14.011	14.096	14.076	14.153	14.246	14.212	14.296	14.396	14.350	14.440	14.548
9	12.556	12.619	12.694	12.692	12.761	12.843	12.830	12.905	12.999	12.969	13.049	13.145
10	11.449	11.506	11.574	11.587	11.649	11.723	11.726	11.793	11.874	11.867	11.938	12.024
11	10.546	10.597	10.659	10.685	10.741	10.808	10.825	10.885	10.958	10.966	11.031	11.109
12	9.793	9.840	9.897	9.934	9.985	10.046	10.075	10.130	10.197	10.218	10.277	10.348
15	8.144	8.181	8.226	8.287	8.327	8.377	8.432	8.476	8.529	8.579	8.626	8.683
20	6.506	6.534	6.567	6.655	6.685	6.722	6.806	6.839	6.878	6.960	6.994	7.036
25	5.536	5.558	5.584	5.690	5.714	5.743	5.848	5.873	5.904	6.008	6.035	6.067
30	4.8990	4.9169	4.9384	5.0592	5.0787	5.1019	5.2225	5.2433	5.2682	5.3880	5.4107	5.4371
40	4.1244	4.1377	4.1532	4.2959	4.3097	4.3262	4.4705	4.4852	4.5028	4.6487	4.6642	4.6827
50	3.6826	3.6924	3.7041	3.8638	3.8741	3.8865	4.0490	4.0600	4.0730	4.2384	4.2498	4.2634

	4 PER CENT			5 PER CENT			6 PER CENT			7 PER CENT		
PERIOD YEARS	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.	MONTHLY INST.	SEMI-ANNUAL INST.	ANNUAL INST.
5	22.100	22.265	22.463	22.645	22.852	23.097	23.200	23.446	23.740	23.761	24.048	24.389
6	18.744	18.912	19.076	19.326	19.497	19.702	19.888	20.092	20.336	20.459	20.697	20.980
7	16.403	16.520	16.661	16.961	17.107	17.282	17.531	17.705	17.914	18.112	18.314	18.555
8	14.627	14.730	14.853	15.192	15.320	15.472	15.769	15.922	16.104	16.360	16.537	16.747
9	13.249	13.341	13.449	13.820	13.934	14.069	14.407	14.542	14.702	15.007	15.163	15.349
10	12.150	12.231	12.329	12.727	12.829	12.950	13.322	13.443	13.587	13.933	14.072	14.238
11	11.252	11.326	11.415	11.837	11.929	12.039	12.441	12.550	12.679	13.061	13.186	13.336
12	10.506	10.574	10.655	11.099	11.183	11.282	11.710	11.809	11.928	12.341	12.455	12.590
15	8.876	8.930	8.994	9.490	9.556	9.634	10.126	10.204	10.296	10.786	10.874	10.980
20	7.272	7.311	7.358	7.919	7.967	8.024	8.597	8.653	8.718	9.304	9.365	9.439
25	6.334	6.364	6.401	7.015	7.052	7.095	7.732	7.773	7.823	8.481	8.527	8.581
30	5.7290	5.7536	5.7830	6.4419	6.4707	6.5051	7.1946	7.2266	7.2649	7.9837	8.0177	.0586
40	5.0153	5.0321	5.0523	5.7864	5.8052	5.8278	6.6025	6.6223	6.6462	7.4572	7.4770	7.5009
50	4.6285	4.6405	4.6550	5.4497	5.4624	5.4777	6.3168	6.3293	6.3444	7.2203	7.2319	7.2460

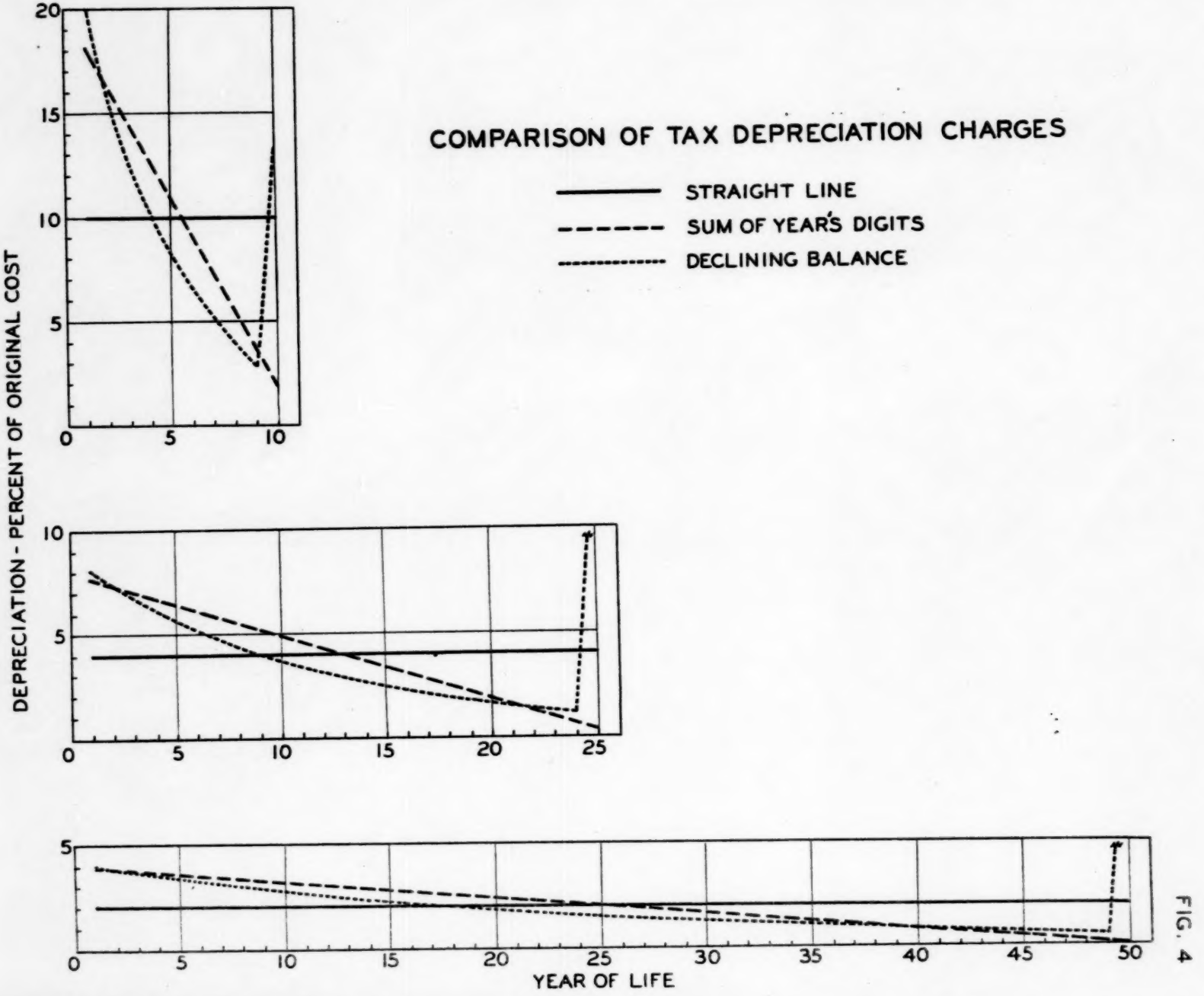

COMPARISON OF TAX DEPRECIATION CHARGES
STRAIGHT LINE
SUM OF YEAR'S DIGITS
DECLINING BALANCE
DEPRECIATION - PERCENT OF ORIGINAL COST
YEAR OF LIFE
0
5
10
15
20
25
30
35
40
45
50

FIG. 4

Fig. 5

DEPRECIATION FACTORS
FOR THE
SUM OF THE YEARS - DIGITS METHOD
AND
PRESENT VALUES THEREOF AT 6%

Year of Life	SERVICE LIFE - YEARS													
	10		20		25		30		35		40		50	
	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value
1	.181818	.171526	.095238	.089847	.076924	.072570	.064516	.060864	.055556	.052411	.048780	.046019	.039215	.036995
2	.163636	.145635	.090476	.080523	.073846	.065723	.062366	.055505	.053968	.048031	.047561	.042329	.038431	.034203
3	.145455	.122127	.085714	.071967	.070769	.059419	.060215	.050558	.052381	.043980	.046341	.038909	.037647	.031609
4	.127273	.100812	.080952	.064122	.067692	.053618	.058065	.045993	.050794	.040234	.045122	.035741	.036863	.029199
5	.109091	.081519	.076190	.056934	.064615	.048284	.055914	.041782	.049206	.036770	.043902	.032806	.036078	.026960
6	.090909	.064087	.071429	.050355	.061538	.043382	.053763	.037901	.047619	.033570	.042683	.030090	.035294	.024881
7	.072727	.048368	.066667	.044337	.058462	.038881	.051613	.034326	.046032	.030614	.041463	.027575	.034510	.022951
8	.054545	.034222	.061905	.038840	.055385	.034749	.049462	.031033	.044444	.027885	.040244	.025250	.033725	.021159
9	.036364	.021524	.057143	.033823	.052308	.030961	.047312	.028004	.042857	.025367	.039024	.023098	.032941	.019498
10	.018182	.010153	.052381	.029249	.049231	.027490	.045161	.025218	.041270	.023045	.037805	.021110	.032157	.017956
11			.047619	.025085	.046154	.024313	.043011	.022658	.039682	.020904	.036585	.019273	.031372	.016526
12			.042857	.021299	.043077	.021408	.040860	.020306	.038095	.018932	.035366	.017576	.030588	.015201
13			.038095	.017860	.040000	.018754	.038710	.018149	.036508	.017116	.034146	.016009	.029804	.013973
14			.033333	.014743	.036923	.016331	.036559	.016170	.034921	.015446	.032927	.014564	.029019	.012835
15			.028571	.011922	.033846	.014123	.034409	.014358	.033333	.013909	.031707	.013230	.028235	.011781
16			.023810	.009373	.030769	.012112	.032258	.012698	.031746	.012497	.030488	.012001	.027451	.010806
17			.019048	.007074	.027692	.010284	.030107	.011181	.030159	.011200	.029268	.010869	.026667	.009903
18			.014286	.005005	.024615	.008624	.027957	.009795	.028571	.010010	.028049	.009827	.025883	.009068
19			.009524	.003148	.021538	.007119	.025806	.008529	.026984	.008919	.026829	.008867	.025098	.008295
20			.004762	.001485	.018461	.005756	.023656	.007376	.025397	.007919	.025610	.007985	.024314	.007581
21					.015385	.004526	.021505	.006326	.023810	.007004	.024390	.007174	.023529	.006921
22					.012308	.003416	.019355	.005371	.022222	.006167	.023171	.006430	.022745	.006312
23					.009231	.002417	.017204	.004504	.020635	.005402	.021951	.005747	.021960	.005749
24					.006154	.001520	.015054	.003718	.019048	.004704	.020732	.005120	.021176	.005230
25					.003077	.000717	.012903	.003006	.017460	.004068	.019512	.004546	.020394	.004752
26							.010753	.002364	.015873	.003489	.018293	.004021	.019609	.004310
27							.008602	.001784	.014286	.002962	.017073	.003540	.018823	.003903
28							.006452	.001262	.012698	.002484	.015854	.003102	.018039	.003529
29							.004301	.000794	.011111	.002051	.014634	.002701	.017255	.003185
30							.002151	.000375	.009524	.001658	.013415	.002336	.016471	.002868
31									.007937	.001304	.012195	.002003	.015686	.002577
32									.006349	.000984	.010976	.001701	.014902	.002309
33									.004762	.000696	.009756	.001426	.014118	.002064
34									.003175	.000438	.008537	.001177	.013333	.001839
35									.001587	.000206	.007317	.000952	.012549	.001633
36											.006098	.000748	.011765	.001444
37											.004878	.000565	.010980	.001271
38											.003659	.000400	.010196	.001114
39											.002439	.000251	.009412	.000970
40											.001220	.000119	.008627	.000839
41													.007843	.000719
42													.007059	.000611
43													.006274	.000512
44													.005490	.000423
45													.004706	.000342
46													.003922	.000269
47													.003137	.000203
48													.002355	.000144
49													.001569	.000090
50													.000784	.000043
Total P.V.	.799973		.676991		.626497		.581908		.542376		.507187			.447555
Annual Equivalent	.108691		.059023		.049009		.042275		.037410		.033709			.028395
Straight Line Rate	.100000		.050000		.040000		.033333		.028571		.025000			.020000
Per Cent of Straight Line	108.691%		118.046%		122.523%		126.826%		130.937%		134.836%			141.975%

WJM.FJMcC
June 14, 1957

Fig. 6

DEPRECIATION FACTORS
FOR THE
DECLINING BALANCE METHOD
(TWICE STRAIGHT LINE RATE X REMAINING BALANCE)
AND
PRESENT VALUES THEREOF AT 6%

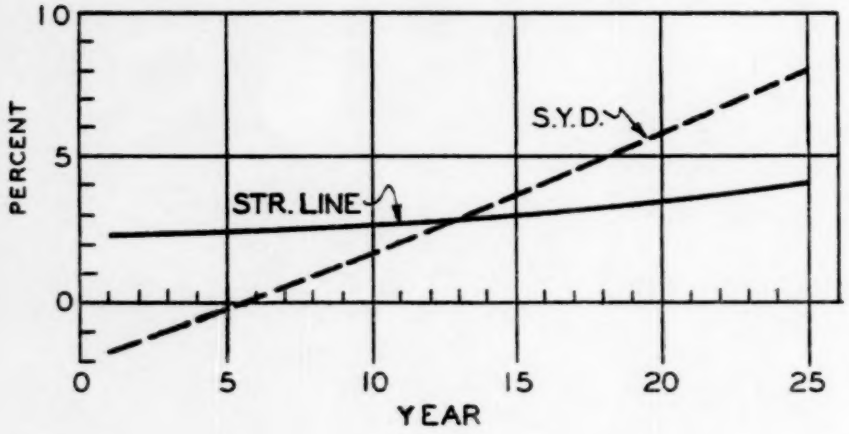
Year of Life	SERVICE LIFE - YEARS															
	10		20		25		30		35		40		50			
	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value	Depr'n Factor	Present Value		
1	.200000	.188679	.100000	.094340	.080000	.075472	.066667	.062893	.057143	.053908	.050000	.047170	.040000	.037736		
2	.160000	.142399	.090000	.080100	.073600	.065504	.062222	.055377	.053878	.047951	.047500	.042275	.038400	.034176		
3	.128000	.107471	.081000	.068009	.067712	.056852	.058074	.048760	.050799	.042652	.045125	.037888	.036864	.030952		
4	.102400	.081110	.072900	.057744	.062295	.049343	.054202	.042933	.047896	.037938	.042869	.033956	.035389	.028031		
5	.081920	.061215	.065610	.049028	.057311	.042826	.050589	.037803	.045159	.033745	.040725	.030432	.033974	.025387		
6	.065536	.046200	.059049	.041627	.052726	.037170	.047216	.033285	.042579	.030017	.038689	.027274	.032615	.022992		
7	.052429	.034868	.053144	.035344	.048508	.032261	.044069	.029308	.040146	.026699	.036755	.024444	.031310	.020823		
8	.041943	.026316	.047830	.030009	.044628	.028000	.041131	.025806	.037851	.023748	.034917	.021907	.030058	.018859		
9	.033554	.019861	.043047	.025479	.041057	.024302	.038389	.022722	.035689	.021124	.033171	.019634	.028856	.017080		
10	.134218	.074947	.038742	.021633	.037773	.021092	.035829	.020007	.033649	.018789	.031513	.017597	.027701	.015468		
11			.034868	.018368	.034751	.018306	.033441	.017616	.031726	.016713	.029937	.015770	.026593	.014009		
12			.031381	.015595	.031971	.015889	.031212	.015511	.029914	.014866	.028440	.014134	.025530	.012688		
13			.028243	.013241	.029413	.013790	.029131	.013658	.028204	.013223	.027018	.012667	.024508	.011490		
14			.025419	.011243	.027060	.011969	.027189	.012026	.026598	.011762	.025667	.011353	.023528	.010406		
15			.022877	.009546	.024895	.010388	.025376	.010589	.025073	.010462	.024384	.010175	.022587	.009425		
16			.020589	.008105	.022904	.009016	.023684	.009323	.023640	.009306	.023165	.009119	.021683	.008535		
17			.018530	.006881	.021071	.007825	.022105	.008209	.022289	.008277	.022006	.008172	.020816	.007730		
18			.016677	.005843	.019386	.006792	.020632	.007228	.021016	.007363	.020906	.007324	.019983	.007001		
19			.015009	.004961	.017835	.005895	.019256	.006364	.019815	.006549	.019861	.006564	.019184	.006341		
20			.135085	.042120	.016408	.005116	.017973	.005604	.018683	.005825	.018868	.005883	.018417	.005743		
21					.015095	.004440	.016774	.004934	.017615	.005182	.017924	.005272	.017680	.005201		
22					.013888	.003854	.015656	.004345	.016608	.004609	.017028	.004725	.016973	.004710		
23					.012777	.003345	.014612	.003825	.015659	.004099	.016177	.004235	.016296	.004266		
24					.011755	.002903	.013638	.003368	.014764	.003646	.015368	.003796	.015642	.003863		
25					.135181	.031497	.012729	.002966	.013921	.003244	.014600	.003402	.015017	.003499		
26							.011880	.002611	.013125	.002885	.013870	.003049	.014416	.003169		
27							.011088	.002299	.012375	.002566	.013176	.002732	.013839	.002870		
28							.010349	.002025	.011668	.002283	.012517	.002449	.013286	.002599		
29							.009659	.001783	.011001	.002030	.011891	.002195	.012754	.002354		
30							.135228	.023545	.010373	.001806	.011296	.001967	.012244	.002132		
31									.009779	.001606	.010732	.001763	.011754	.001931		
32									.009220	.001429	.010195	.001580	.011284	.001749		
33									.008693	.001271	.009685	.001416	.010833	.001584		
34									.008197	.001130	.009201	.001269	.010399	.001434		
35									.135260	.017598	.008741	.001137	.009983	.001299		
36											.008304	.001019	.009584	.001176		
37											.007889	.000913	.009201	.001065		
38											.007494	.000819	.008833	.000965		
39											.007120	.000734	.008479	.000874		
40											.135276	.013152	.008140	.000792		
41													.007815	.000717		
42													.007502	.000649		
43													.007202	.000588		
44													.006914	.000532		
45													.006637	.000482		
46													.006372	.000437		
47													.006117	.000396		
48													.005872	.000358		
49													.005637	.000324		
50													.135301	.007345		
Total P.V.		.783066		.639216		.583847		.536723		.496301		.461362		.404232		
Annual Equivalent		.106394		.055730		.045673		.038992		.034232		.030663		.025646		
Straight Line Rate		.100000		.050000		.040000		.033333		.028571		.025000		.020000		
Per Cent of Straight Line		106.394%		111.460%		114.183%		116.977%		119.814%		122.652%		128.230%		

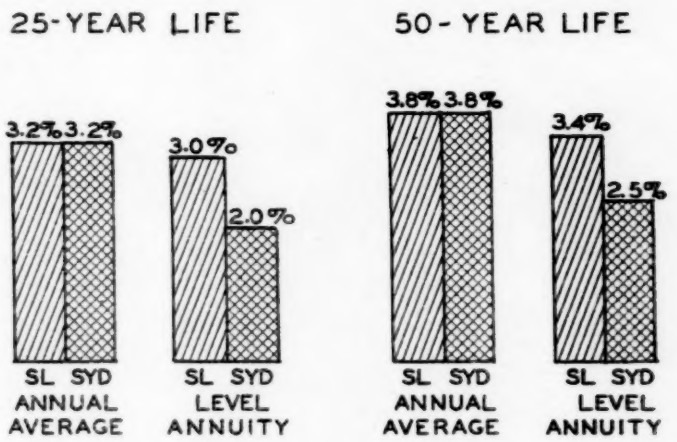
WJH.FJMcC
June 14, 1957

FEDERAL INCOME TAX

(PERCENT OF ORIGINAL COST - ZERO SALVAGE)

STRAIGHT-LINE VS SUM-OF-THE-YEARS-DIGITS DEPRECIATION





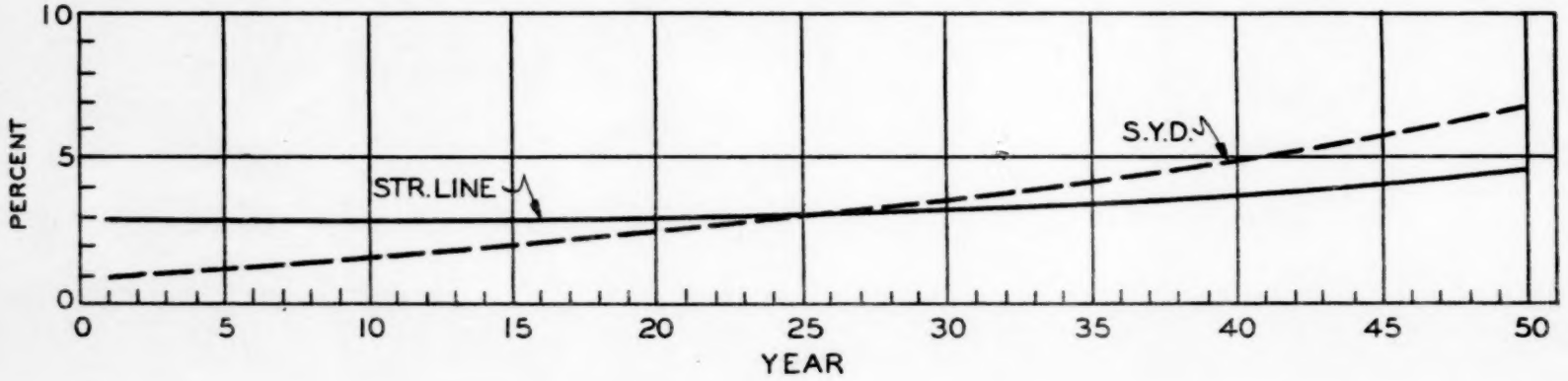


FIG. 7

FIXED CHARGES

OVEC vs CON EDISON

		OVEC		CON ED	
CAPITALIZATION	BONDS	80%		50%	
	NOTES			-	
	EQUITY	20		50	
		100%		100%	
COST OF MONEY - %	BONDS	3 3/4		3 1/4	
	NOTES	4		-	
	EQUITY	8		7 3/4	
OVERALL RATE OF RETURN	BONDS	3.00%		1.625%	
	EQUITY	1.60		3.875	
	TOTAL	4.60		5.50	
ANNUAL CHARGES - %					
INTEREST			3.00		1.625
COMMON NET EARNINGS		1.60	1.60	3.875	3.875
AMORTIZATION (30 YEARS)		1.58	1.58	1.35	1.35
		3.18	6.18	5.225	6.85
STRAIGHT LINE DEPRECIATION (40 YRS)		2.45		2.45	
TAXABLE EARNINGS		0.73		2.775	
INCOME TAX (50% RATE)			0.73		2.78
PROPERTY TAXES AND INSURANCE			1.50		3.50
TOTAL			8.41		13.13

FIG. 8

TOTAL COSTS

(FOR BASE LOAD OPERATION)

	OVEC	CON ED
CAPABILITY - MEGAWATTS	2 365	350
ASSUMED CAPACITY FACTOR	90%	90%
CORRESPONDING NET GENERATION-KWH	18650×10^6	2760×10^6
FIXED CHARGES		
COST PER KILOWATT	$168	$210
FIXED CHARGE RATE	8.41%	13.13%
ANNUAL COST PER KILOWATT	$14.15	$27.60
ANNUAL COSTS PER KILOWATTHOUR		
FIXED CHARGES	0.180¢	0.350¢
FUEL COST	0.166	0.322
LABOR AND MAINTENANCE-PRODUCTION	0.038	0.042
LABOR AND MAINTENANCE-TRANSMISSION	0.003	0.001
TOTAL	0.387¢	0.715¢

FIG. 9

EQUIPMENT REPLACEMENT AND DEPRECIATION POLICY

by

Gerald J. Matchett
Illinois Institute of Technology

What policies do firms use in deciding when to replace old equipment? How do firms decide whether or not to make new capital acquisitions? Answers to these questions not only are interesting in themselves, but also throw light on the process of capital formation in our economy. Furthermore, if it could be established that most firms use some objective method for making decisions regarding capital acquisition and replacement, knowledge of the method would aid materially in making more adequate forecasts of capital formation and in predicting the rate of economic growth. Such knowledge should also be useful to capital goods producers in planning future capacity.

REPLACEMENT POLICY IN THE CAPITAL GOODS INDUSTRY

More information is available regarding equipment policies and practices in the capital goods industry than in any other. This information has resulted from the surveys conducted by the Machinery and Allied Products Institute -- one in 1948 and one in 1956.[1] In the 1956 survey, a rather elaborate questionnaire was distributed to 491 manufacturers of capital equipment. An excellent response was obtained. A total of 296 replies could be tabulated -- about a 60 per cent return.

The tabulation of the results reveals that 54 per cent of the firms have an individual or staff with special responsibility

for equipment analysis and that 79 per cent review regularly their equipment situation for the purpose of appraising the possibility of improvement and modernization. These figures become highly impressive when they are compared with those of the 1948 survey. In 1948 only 28 per cent of the companies reported an individual or staff with responsibility for making economy studies and only 35 per cent claimed to make a regular review of their equipment.

Although more firms indicated the use of the payoff method of analysis than any other, a surprisingly large number reported the adoption of one of the more scientific approaches to equipment replacement. Of the firms responding to the survey and indicating the use of a particular method, the percentages are as follows: payoff period, 42 per cent; MAPI method, 19 per cent; minimum average cost, 8 per cent; and discounted cash flow, 1 per cent.

When the payoff period is used, the firm generally chooses a period that is only a small fraction of the normal service life of the new equipment. It is interesting to note that the 1956 survey may indicate somewhat of a trend toward a more realistic and progressive policy. In the 1948 survey, 58 per cent of the firms using the payoff method reported payoff periods in excess of three years while in the 1956 survey 62 per cent of the firms reported using payoff periods in excess of three years. In fact in the latter survey, more firms -- 34 per cent -- reported the use of a five year period than any other and 16 per cent reported the use of periods exceeding five years.

The results of the questionnaire in general bear out a conclusion contained in the report that "the past several years

have witnessed the beginning of a revolution in what was, until recently, a backward area of management -- equipment policy". The survey makes quite clear that firms in the capital goods industry have become more cognizant of the importance of analyzing their equipment policy objectively. The capital goods industry as a whole is probably more conscious of the importance of this area of analysis than other industries for two reasons. First, the fact that firms in this industry are producing and selling capital equipment makes them more aware of their own equipment policy. Second, a great deal of effective educational work has been done in this industry by organizations like the Machinery and Allied Products Institute, the National Machine Tool Builders' Association and others.

Nevertheless there is evidence of a growing awareness of the importance of a sound equipment policy in other industries and a trend toward the adoption of objective analytical techniques. It is inevitable that equipment practices developed in the capital goods industry will spread to other industries.

DEPRECIATION POLICY IN THE CAPITAL GOODS INDUSTRY

The 1956 survey also brought to light interesting information regarding depreciation practices. Prior to the adoption of the Internal Revenue Code of 1954, practically all firms used straight-line depreciation. The taxpayer could choose declining-balance at one and one-half times the straight-line rate, but the results were unfavorable as compared with straight-line depreciation.

The 1954 Code gave the taxpayer a wider range of choice. He could elect straight-line depreciation, double declining-balance, or sum-of-the-digits depreciation. The last two methods provide a much faster write-off than straight-line depreciation. Roughly two-thirds of the value of the asset can be written off during the first half of the life of the asset.

The survey reveals that about two-thirds of the firms have adopted one of the faster depreciation methods. To the question regarding the method of depreciation used for tax purposes on assets acquired since 1953, the percentages are as follows: straight-line, 36 per cent; double-declining-balance, 31 per cent; sum-of-the-digits, 31 per cent; and others, 2 per cent.

With this choice of the new methods, it is interesting that 71 per cent of the firms believe current methods of distributing depreciation over the service life are adequate. However, only 55 per cent believe life estimates as contained in Bulletin F are satisfactory.

A powerful argument in favor of the faster write-off has been the contention that it would lead to more realistic book values and a more realistic reporting of profit. Evidence seems to point to the fact that industrial assets actually lose more of their value during the early years of life. This argument would be invalidated if it were found that firms follow a general practice of using the faster depreciation methods for tax purposes but use straight-line depreciation in reporting to stockholders. Under this practice, large amounts of profits that had not been subjected to tax would appear in reports to stockholders. This

practice, however, does not appear to be widely prevalent in the capital goods industry. In the MAPI survey, 85 per cent of the firms reported using the same depreciation rates for both book and income tax purposes. In interpreting this figure, one should recognize, of course, that the 15 per cent reporting the opposite practice would come entirely from the group of 62 per cent that have adopted one of the faster methods for tax purposes.

The surveys regarding equipment and depreciation policies conducted by the Machinery and Allied Products Institute have revealed interesting and significant business practices. The organization has done a real service for the capital goods industry. Similar surveys in other industries would be most welcome.

1. The 1956 survey is available in a pamphlet entitled Equipment and Depreciation -- Policies and Practices, Machinery and Allied Products Institute, 1200 Eighteenth Street, N.W., Washington 6, D. C. The price for single copies is $1.00.

Review Article

RAPID AMORTIZATION OF EMERGENCY FACILITIES*

Review by

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It has been said that "it is economics, not love, that makes the world go around". This sobering thought, at odds though it may be with what poets would have us believe, was proven again to be a truism back in 1940 when Hitler invaded France. Due to the high "normal" and excess profits taxes just passed, it became necessary for the Congress to grant special relief from this tax deterrent for selected industries in order to spur the necessary new construction for industrial production of defense goods.

The legislation (section 124 of the Internal Revenue Code) allowed defense agencies to grant certificates of necessity for new construction, allowing the holder to amortize for tax purposes the cost of the new facilities over five years instead of the normal 33-1/3 to 40 years. It was the intent of Congress to allow essential industries to amortize rapidly those investments that would have little value after the emergency passed.

Following World War II the legislation was repealed. However, with the beginning of the Korean emergency, tax rates were again increased and an excess profits tax was again imposed.

* Hearings before the Committee on Finance, United States Senate, Eighty-Fifth Congress, First Session on S. 1795, May 7 and 9, 1957; United States Government Printing Office, Washington 25, D.C.

Also, rapid amortization of defense related facilities was again allowed under section 124A of the Internal Revenue Code approved by Congress in September, 1950.

The procedure followed was that the Office of Defense Mobilization would issue certificates of necessity to essential industries covering some portion of the proposed investment. ODM had established, on the basis of recommendations from the appropriate government agencies, expansion goals covering required defense production expansion.

The portion of the new investment that would be certified for fast tax write-off was based on "the probable economic usefulness of the facility for other than defense purposes after five years". ODM would then issue certificates to applicants to fill the expansion goals.

For example, in 1952, expansion goal number 55 for electric power was established at 117 million kilowatts by December 31, 1956, an increase of 56% in 5 years. The program was thus attempting to encourage expansion far beyond the normal growth needs of the power utilities, thereby providing a mobilization reserve. By November, 1953, when the goal was temporarily suspended, applications covering new construction of $4.2 billion providing an additional capacity of 21 million kilowatts had been approved, of which $1.9 billion had been certified for the five year tax write-off.

By the end of the Korean War, a total of 16,000 certificates covering about $21 billion of new construction had been authorized, of which about $16 billion had been certified for rapid amortization. (The latter amount compares with a total of

only $7.3 billion certified for rapid write-off during the World War II emergency.)

Since the Korean War a total of 6,000 certificates covering $18 billion have been authorized of which about $7 billion have been certified.

SENATE HEARINGS

It is primarily toward the certificates issued since the Korean War that the Senate Finance Committee addressed its attention when it began hearings in May of this year on legislation to curtail drastically the rapid amortization program.

Under consideration was the "Emergency Facility Amortization Act of 1957" (S. 1795), a bill sponsored by the able committee chairman, Senator Harry F. Byrd. The bill would:

"amend section 168 of the Internal Revenue Code of 1954, so as to restrict the issuance of certificates for rapid amortization of emergency facilities to those facilities producing . . . (A) new defense items or components of new defense items . . . . during the emergency period, or (B) to provide research, developmental, or experimental services during the emergency period for the Department of Defense . . .or for the Atomic Energy Commission, as a part of the national defense program" where "existing facilities are unsuitable because of /the new defense item's/ newness or of its specialized defense features."

At the time of the hearings ODM was holding open only 8 of the original 229 expansion goals established since 1950, and 5 of these were undergoing a new review to determine the feasibilty of continuing them. The Senate bill was to reduce these still further.

The hearings began with insertion in the record of statements by Percival Brundage, Budget Director; Sinclair Weeks, Secretary of Commerce; Robert Dechert, Defense Department General

Counsel; and George Humphrey, Secretary of the Treasury, all of whom supported the bill subject to minor changes which in general would expand the coverage of the bill to include transportation facilities and scarce strategic minerals, metals, and gases for direct military or atomic energy requirements.

The more salient points brought out in the testimony before the committee follow.

The able Secretary Humphrey summarized the case against rapid amortization, making the following points:

> (1) Rapid amortization is causing a treasury revenue lag exceeding $5 billion, resulting in additional interest cost to the government of $3 billion.
> (2) The savings to industry in taxes tends to act as a stimulus to inflation.
> (3) When rapid amortization is granted for facilities which will enter civilian markets later, the result is "dislocations and unfair advantages between whole industries and individual companies within an industry". Much of the rapid write-off has been granted for these types of facilities. For example, "over 14% of the total amortizable cost of facilities through December 28, 1955, was granted to utilities and sanitary services; over 16% more went to railroads; and about 20% went to primary metal industries. Other whole industries had none.
> (4) " . .Getting funds for the construction of new plants and facilities is a continuing serious problem. High tax rates make it harder to save from current income . . . .It is essential to reduce tax rates as rapidly as can be done soundly. But tax reduction for favored groups only postpones the day when general tax reduction can be enjoyed by all the people."

Mr. Alexander Hudgins (Virginia Association of Electric Cooperatives) also testified in favor of the legislation, agreeing with and citing specific examples in support of Secretary Humphrey's contention of the abuse of the granting of certificates.

Mr. Hudgins explained particularly the following case history. The Virginia Electric Power Company applied for a license for its Roanoke Rapids hydroelectric project two years

before the Korean War, and was issued the license to build by the Federal Power Commission two months before the war. The FPC Chief Presiding Examiner, in granting the license, concurred with VEPCO's claim that additional generating capacity was then needed to serve the area (for normal civilian requirements), and that no Federal funds would be required. In addition, in late 1950, the Examiner again stated that the project would be undertaken by VEPCO "without the aid of the Federal Treasury . . ." However, in 1953, VEPCO was issued, in reply to its application, a rapid tax amortization certificate by ODM for the project.

Gordon Gray, Director of ODM, testified that his bureau has been administratively approaching the same general goals that the proposed legislation would bring about.

He listed the following eight expansion goals which are still open, the last five of which were at the time under serions consideration for termination:

(1) Research and Development Laboratories for defense use.
(2) Liquid oxygen and nitrogen for defense purposes.
(3) Production facilities for military and AEC procurement.
(4) Nickel production.
(5) Mica substitutes.
(6) Steam turbines.
(7) Steel castings.
(8) Roll-on, roll-off ships.

Of particular concern to the committee was Mr. Gray's certification, only two weeks earlier, allowing rapid write-off of $65 million for the Idaho Power Company for two hydroelectric dams to be built on the Snake River at Brownlee and Oxbow. It was the strong belief of the committee that certification of private utility construction, especially in peacetime, was a miscarriage of the intent of the rapid amortization program. A

utility is permitted by its regulatory body a pricing structure (based on normal depreciation) sufficient to allow it a reasonable rate of return on its investment. Rapid write-off, then, provides the utility with excess profits at the expense of the consumer and the government.

Mr. Gray defended the granting of the rapid amortization certificate on the grounds that the application had been filed in 1953 under a then-open expansion goal properly established in cooperation with the recommendations of appropriate government agencies, and that Idaho Power had fulfilled all of the requirements to be certified (not the least of which was the fact that there were 66 important defense plants within the Idaho Power pool).

Of particular interest is the prepared statement and testimony of Clay L. Cochran (of the National Electric Cooperative Association). He explained some of the compound interest aspects of the rapid amortization program. His presentation was substantially as follows:

EXHIBIT I

Estimated benefits accruing to a commercial electric corporation under accelerated tax amortization certificates.

Assumptions: Investment, $2,000,000. Total period of amortization and depreciation, 33-1/3 years. Amount subject to 5 year write-off (50%), $1,000,000.

Total value of certificates issued	$1,000,000
Depreciation per year based on certificate	200,000
Less normal 3% depreciation	30,000
Excess depreciation per year	$ 170,000
Annual tax savings, years 1-5 (52% of $170,000)	88,400
Annual tax paid, years 6-33-1/3 (52% of $30,000)	15,600

The cumulative total benefits derived from rapid amortization over the whole 33-1/3 years, as shown in Exhibit II, is thus $1,502,564, or more than one and a half times the amount certified. In addition, this "is a very conservative estimate since it

"(1) disregards the very real chance of a future reduction in Federal corporate income taxes; (2) omits any cost to the company of raising comparable amounts of money in the money market; (3) assumes that the company will not make [or earn on its outside investments] in excess of 6% - - - "

DISCUSSION OF THE HEARINGS

The one point on which the Senate committee members and many of those who testified before it agree is that under certain circumstances there is justification for some form of economic incentive to be given to private industries producing defense goods. It is indeed incongruous for the government to <u>force</u> industry to produce the very goods that will help insure the country's (and hence industry's) freedom.

It is beyond the scope of this paper to investigate why the economic incentive has taken the form of an accelerated amortization over a 5-year period rather than a direct subsidy as suggested by members of the Senate committee.

Several examples of the apparent abuse of the rapid amortization program were testified to before the committee. It is admittedly difficult to administer any system perfectly that is controlled by the mutual cooperation of many large government agencies and directly affects as many complex industries as has the rapid amortization program. In addition, it is always easy

to second-guess specific decisions made five to seven years ago during an emergency.

However, the writer is very much in agreement with Secretary Humphrey and others who testified concerning the competitive imbalance produced in an otherwise free economy. This is especially true when the facilities certified are later used for normal civilian needs due to growth of civilian consumption, and would have to have been built anyway sooner or later in anticipation of this demand.

In any event, the economic aspects of the rapid amortization program are particularly interesting. Rapid amortization is essentially an interest free loan of 52% of the amount certified, paid to the builder evenly over five years and repaid by him at 2-1/2 to 3% per year over 33-40 years, for buildings (or at 5 to 6-2/3% per year over 15-20 years for machinery and equipment). Although Mr. Cochran's explanation of this is correct arithmetically, it gives an extremely misleading conclusion. What is pertinent is not that a certification of $1 million resulted in net benefits or subsidy, 33-1/3 years hence, of $1,502,564, but rather that the resulting subsidy was the present worth of this amount (discounted at 6%), or $215,467 -- only 21.5% of the amount certified. In other words, ODM is saying in effect that they believe, in this example, that one half of the $2,000,000 facility is excess, reserve capacity, and that they will pay for 21.5% of the cost of the excess capacity.

A simpler approach, resulting in substantially the same answer, to the value of the subsidy now, is to determine the present worth of the $88,400 for the first 5 years less the present

worth of $15,600 for 28 years (years 6-33) less the present worth of $5200 in the 34th year. This results in a net present worth of $215,309, (where i = 6%).

However, the industrial subsidy of $215,309 does not represent the cost to the government. Assuming an effective interest rate for the government of 3%, the calculation made in the previous paragraph would result in a present worth of only $150,432. Hence, ODM is in effect saying, "If you build your $2,000,000 dam, half of which we believe will be excess capacity, we will give you a subsidy, worth $215,309 to you, while costing the government $150,432."

These calculations are made on the assumption that the alternatives available to the government are:

(1) to grant the subsidy (certify the 5-year rapid amortization) or

(2) not grant the subsidy and assume that the facility will be built anyway in anticipation of growing civilian demands.

However, assume the alternatives available to the government are:

(1) to grant the subsidy, or

(2) not grant the subsidy and not have the resulting mobilization reserve available.

In this case, if the rapid amortization were granted and the facility were built, <u>any</u> taxes paid would be a net gain for the government. If it were not granted, there would be no tax revenue from the source at all.

Assume, then, that a certain facility will be built only if

it is certified, that it will, as before, cost $2,000,000 of which $1,000,000 will be allowed the rapid write-off, and that it will earn, on the average over its 33-1/3 year life, 6% per year of its book value at the beginning of each year based on 3% per year depreciation. The earnings may come from new products, government contracts, or in later years, from an expanding economy.

Exhibit III is a schedule of (1) the anticipated net yearly earnings before depreciation and taxes, (2) the facility's depreciation (3% of $1 million plus 20% of $1 million), (3) its taxable income for the year, (4) its cumulative tax loss (to be carried forward and absorbed in later years), and (5) taxes paid because of the facility (52% of the smaller of (3) or (4) when positive). The same simplifying assumptions made in Exhibit II were made here also. The present worth of these taxes, or the value to the government now of granting the rapid amortization, is $402,742 (when discounted at 6%), more than 40% of the amount allowed the fast write-off.

There is no way of determining how many of the 22,000 certificates issued since 1950 represented facilities that fell under the former or the latter set of assumptions. Undoubtedly, however, many did fall under the latter set, being made economically feasible only because they were granted a rapid amortization.

Thus, rapid amortization, while having a stimulating effect on the economy, may also be in some cases advantageous rather than apparently detrimental to the Federal Treasury.

CONCLUSIONS

Inasmuch as the original purpose of the rapid amortization program -- to speed construction of facilities essential to the prosecution of war -- has ceased to exist, section 124A has been dying a slow death. Since the Senate hearings in May, S. 1795 was passed essentially unchanged by both houses of Congress and signed into law by the President, August 26. In its final form the provisions of S. 1795 became part of another bill (H.R. 232) and became effective August 22. In addition, it ends all rapid write-offs of any sort after December 31, 1959.

But, although admittedly abused at times, section 124A served the worthy purpose of supplying defense industries the necessary economic incentive to expand rapidly in time of war, and economic stimulation to grow in times of quasi-war.

Nor was it as harmful, all things considered, to the Federal Treasury as one might be led to believe. As has been demonstrated, the government as a result of rapid amortization obtains $1,000,000 of mobilization reserve facilities at a cost of only $150,000 (assuming the facility would probably be built anyway, but perhaps at a later date), or receives the equivalent of $403,000 in additional taxes from certifying a $1 million facility (assuming the facility would not otherwise be built).

But now that the 5-year write-off is all but dead, one wonders when will appropriate improvements be made in the "normal" depreciation provisions so as to allow a healthy level of industrial expansion. The government admitted these provisions were inadequate by introducing rapid amortization.

EXHIBIT II

(Computation of total benefits derived by commericial electric corporations for an accelerated amortization certificate of $1,000,000)

Year	Cumulative total benefits	6% interest per annum	Interest free loan[1]	Deferred taxes paid[2]	Net benefits each year
1	-- $ -------	$ ------	$ 88,400	$ ------	$ 88,400
2	------ 88,400	5,304	88,400	------	93,704
3	------ 182,104	10,926	88,400	------	99,326
4	------ 281,430	16,886	88,400	------	105,286
5	------ 386,716	23,203	88,400	------	111,603
6	------ 498.319	29,899	------	15,600	14,299
7	------ 512,618	30,757	------	15,600	15,157
8	------ 527,775	31,666	------	15,600	16,066
9	------ 543,841	32,630	------	15,600	17,030
10	------ 560,871	33,652	------	15,600	18,052
11	------ 578,923	34,735	------	15,600	19,135
12	------ 598,058	35,883	------	15,600	20,283
13	------ 618,341	37,100	------	15,600	21,500
14	------ 639,841	38,390	------	15,600	22,790
15	------ 662,631	39,758	------	15,600	24,158
16	------ 686,789	41,207	------	15,600	25,607
17	------ 712,396	42,744	------	15,600	27,144
18	------ 739,540	44,372	------	15,600	28,772
19	------ 768,312	46,099	------	15,600	30,499
20	------ 798,811	47,929	------	15,600	32,329
21	------ 831,140	49,868	------	15,600	34,268
22	------ 865,408	51,924	------	15,600	36,324
23	------ 901,732	54,104	------	15,600	38,504
24	------ 940,236	56,414	------	15,600	40,814
25	------ 981,050	58,863	------	15,600	43,263
26	---- 1,024,313	61,459	------	15,600	45,859
27	---- 1,070,172	64,210	------	15,600	48,610
28	---- 1,118,782	67,127	------	15,600	51,527
29	---- 1,170,309	70,219	------	15,600	54,619
30	---- 1,224,928	73,496	------	15,600	57,896
31	---- 1,282,824	76,969	------	15,600	61,369
32	---- 1,344,193	80,652	------	15,600	65,052
33	---- 1,409,245	84,555	------	15,600	68,955
34[3]	---- 1,478,200	29,564	------	5,200	24,364
TOTAL	$1,502,564	$1,502,564	$442,000	$442,000	$1,502,564

[1]Federal corporation income taxes deferred.
[2]Deferred taxes assumed to be payable after facilities have been depreciated 100 per cent.
[3]On assumption of 33-1/3 years as average life of facilities, interest, taxes and net annual benefits are reduced to 1/3 for 34th year.

EXHIBIT III

Schedule of income taxes paid by a $2,000,000 facility of which $1,000,000 (50%) has been allowed rapid amortization. Present worth (at 6%) of taxes paid: $402,742.

Year	(1) Net income	(2) Depreciation	(3) Taxable income	(4) Cumulative tax loss	(5) Income taxes 52% of the smaller of (3) or (4) when +
1	$180,000	$230,000	$(50,000)	$(50,000)	$ 0
2	176,400	230,000	(53,600)	(103,600)	0
3	172,800	230,000	(57,200)	(160,800)	0
4	169,200	230,000	(60,800)	(221,600)	0
5	165,600	230,000	(64,400)	(286,000)	0
6	162,000	30,000	132,000	(154,000)	0
7	158,400	30,000	128,400	(25,600)	0
8	154,800	30,000	124,800	99,200	51,484
9	151,200	30,000	121,200		63,024
10	147,600	30,000	117,600		61,152
11	144,000	30,000	114,000		59,280
12	140,400	30,000	110,400		57,408
13	136,800	30,000	106,800		55,536
14	133,200	30,000	103,200		53,664
15	129,600	30,000	99,600		51,792
16	126,000	30,000	96,000		49,920
17	122,400	30,000	92,400		48,048
18	118,800	30,000	88,800		46,176
19	115,200	30,000	85,200		44,304
20	111,600	30,000	81,600		42,432
21	108,000	30,000	78,000		40,560
22	104,400	30,000	74,000		38,688
23	100,800	30,000	70,800		36,816
24	97,200	30,000	67,200		34,944
25	93,600	30,000	63,600		33,072
26	90,000	30,000	60,000		31,200
27	86,400	30,000	56,400		29,328
28	82,800	30,000	52,800		27,456
29	79,200	30,000	49,200		25,584
30	75,600	30,000	45,600		23,712
31	72,000	30,000	42,000		21,840
32	68,400	30,000	38,400		19,968
33	64,800	30,000	34,800		18,096
34	21,200	10,000	11,200		5,824

Review

ENGINEERING ECONOMY*
Second Edition

This book has been written specifically to serve as a textbook in engineering economy for engineering students and for young engineers. Its aim is to demonstrate the importance of economic factors in engineering application and then to help the student develop sound attitudes and useful methods of analysis in coping with these factors. An extremely wide range of concepts and methods are discussed. All are well illustrated by concrete examples.

The revisions incorporated in this second edition are changes made primarily to give increased emphasis to the fundamental principles of engineering economy. In addition, a new chapter has been added to cover the computation of Federal income taxes, both personal and corporate, and to cover methods for considering the effect of these taxes when making engineering economy studies. The chapter dealing with economic factors involved in organization planning and in the selection and utilization of personnel has been expanded. Also, the formulas advocated for replacement studies by the Machinery and Allied Products Institute are discussed briefly in this new edition.

* ENGINEERING ECONOMY, Second Edition, 1957. H. G. Thuesen. Prentice-Hall, Inc., Englewood Cliffs, N.J. 581 pp. $6.95.

All the textbook features incorporated in the first edition have been retained. One of the most useful of these is a simple scheme of notation used in the illustrative examples to show for each interest factor used its identity and its source in the interest tables at the end of the book. This feature is particularly useful in examples for which a number of conversions are required to put alternative series of expenditures on an equivalent basis. Another useful feature in discussing problems of equivalence is the use of simple time diagrams on which are shown along a scale of interest periods the actual payments or amounts and the computed equivalent sums. All commonly used methods for the application of interest formulas and factors in placing prospective disbursements and receipts for alternative proposals on an equivalent basis are clearly discussed and illustrated. Some emphasis has been placed on determining by interpolation in the interest tables the rate of interest or the number of interest periods that make alternative proposals equivalent.

In describing the various classifications and concepts of cost, careful attention seems to have been given to the discussion of sunk cost and to correct methods for comparison of alternatives when sunk costs are involved. The proper consideration of sunk cost is, in the experience of the reviewer, a difficult topic for the average student. The material on accounting and cost accounting methods is quite brief, but perhaps is adequate to show the need for careful evaluation of accounting data before it is used in making engineering economy studies.

A chapter on the analysis of proposals for a new activity is included. It is of particular interest because it points out in considerable detail the many irreducible factors in economy studies that may have to be considered along with the factors that can be reduced to money terms. A small part of this chapter covers methods of financing an enterprise and the possible effects of the different methods on the rate of return on the owner's investment. A more complete discussion of this subject might have been helpful.

The book may be of some use as a general reference for the engineer at work in industry. It discusses specific approaches for a great many types of problems, particularly those in the areas of manufacturing and industrial management. Among such problems are economy of tool maintenance, economy of crew size, economy of providing for future needs, economic production-order quantities, manufacturing to variable demand, economy of jigs and fixtures, and the relationship of the span of control to economy, to mention only a few. The irreducible factors that may have to be considered along with the reducible factors are pointed out. Another feature that may be of particular use to the practicing engineer rather than the student is the chapter on the making of estimates and on the treatment of estimates in engineering economy studies. In addition to the general coverage of the problem of making estimates, various methods of allowing for possible error in estimates are discussed.

Many related topics from the field of general economics, such as the law of supply and demand, the law of diminishing return, competition and monopoly are discussed. While the

inclusion of this material may be of some help for the student who has not studied economics, it tends to break up the continuity of discussion of engineering economy. Also, the material on engineering economy itself seems to the reviewer to be to some extent disorganized. In the use of the book as a text some care may have to be taken in making reading assignments and in planning class discussions so as to develop general concepts and general methods of approach, rather than specific techniques for specific problems of application.

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